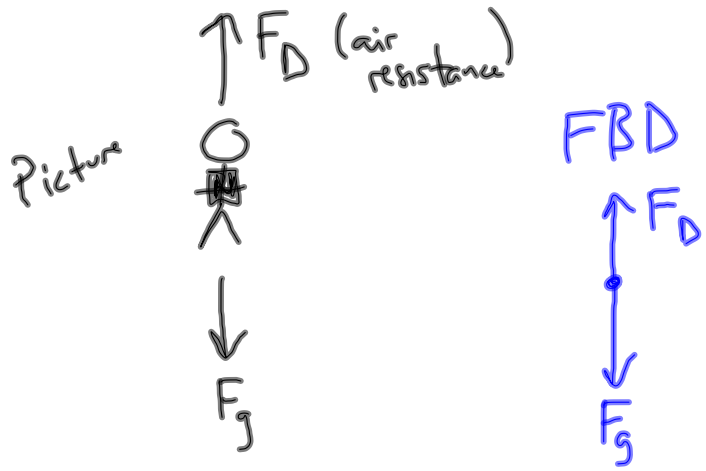
Free-Body Diagrams: (FBDs)

- Draw all forces acting on an object
- Draw object as a point
- Forces are represented as vectors, and the length of the arrow proportional to the magnitude of the force
- Head of vector goes on dot

Example:



Weight:

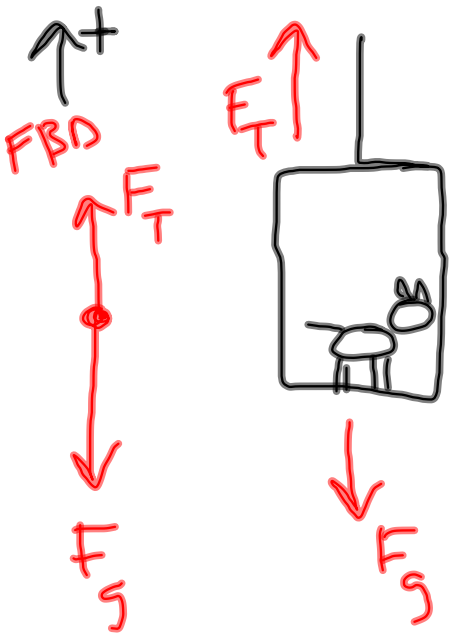
- Measure of the affect of the acceleration due to gravity on an object

- Calculate using Newton's 2nd Law:

$$F_g = ma_g$$

direction of F_g is same as a_g, which is downwards.

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to keep the cat/elevator pair hanging without moving?



$$M = m_c + m_e$$

$$= 2\,kg + 97\,kg$$

$$= 99\,kg$$

*Equilibrium problem

$$\sum \vec{F} = m\vec{a} \rightarrow \emptyset$$

$$F_T + (-F_g) = \emptyset$$

$$F_T = F_g$$

always plug in $9.8\,m/s^2$ for a_g

$$= ma_g$$

$$= (99\,kg)(9.8\,m/s^2)$$

$$= 970.2\,N$$

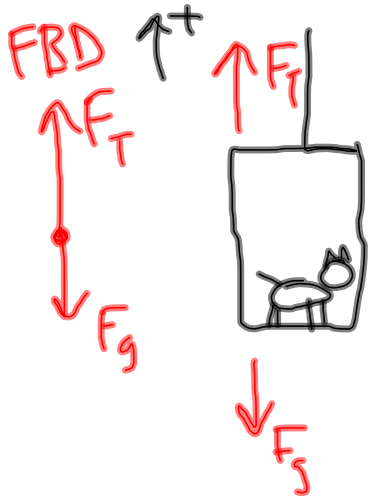
A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to raise the cat/elevator pair upwards with a constant velocity?

→ means no acceleration!

Equilibrium problem,

So the math is the same as the previous page

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed to raise the cat/elevator pair upwards with an acceleration of 2.00 m/s/s upwards?



* Non-equilibrium

$$\sum \bar{F} = m\bar{a}$$

$$F_T - F_g = m\bar{a}$$

$$F_T = F_g + m\bar{a}$$

$$= mg + m\bar{a}$$

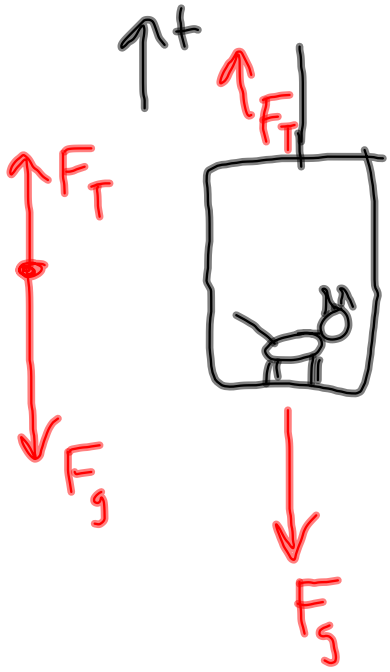
$$= m(g + \bar{a})$$

$$= (59\,kg)(9.8\ m/s^2 + 2\ m/s^2)$$

$$= 1168\ N$$

$$1\ N = 1\ kg \cdot m/s^2$$

A 2.00 kg cat is in a 97.00 kg elevator. What force on the elevator cable would be needed t lower the cat/elevator pair downwards with an acceleration of 2.00 m/s/s downwards?



* Non-equilibrium

$$\sum \vec{F} = m\vec{a}$$

$$F_T - F_g = m\vec{a}$$

$$F_T = mg + m\vec{a}$$

$$= m(g + \vec{a})$$

$$= (99\,kg)(9.8\,m/s^2 - 2\,m/s^2)$$

$$= 772\,N$$